(12) UK Patent Application (19) GB (11) 2 302 293 (13) A

(43) Date of A Publication 15.01.1997

(21) Application No 9512247.9

(22) Date of Filing 16.06.1995

(71) Applicant(s)
**John James Todd**
**61 Sandy Lane, HARTLEY WINTNEY, Hampshire, RG27 8BT, United Kingdom**

(72) Inventor(s)
**Douglas Albert Newell**

(74) Agent and/or Address for Service
**Urquhart-Dykes & Lord**
**91 Wimpole Street, LONDON, W1M 8AH, United Kingdom**

(51) INT CL$^6$
**B29B 9/16**

(52) UK CL (Edition O )
**B2E** EFBA E1111 E1205 E1208 E1212 E1214 E1329 E473S E511T
**U1S** S1434

(56) Documents Cited
**GB 1345811 A** **WO 95/17351 A**
**Abstracts of JP 05038719 A (Polyplastics Co.)**

(58) Field of Search
UK CL (Edition ) **B2E**
INT CL$^0$ **B05D , B29B , B32B**
**Online: EDOC, JAPIO, WPI**

# (54) Method of coating granules

(57) Thermoplastic granules (such as polyethylene granules) are provided at a temperature below their softening temperature. Mineral grains, for example a mixture of sand and salt grains, are heated to a temperature greater than the softening temperature of the plastics material granules. The granules and the heated grains are tumbled together so that the granules become coated with the grains, and the coated granules are allowed to cool while the tumbling preferably continues. The hot coated granules can be at least partially cooled by the addition of an excess of cold grains. After cooling, the salt grains are dissolved away in water leaving the granules coated substantially solely with the sand grains.

These particles are then particularly suitable for use as a fluidizable bed in waste water treatment plants.

GB 2 302 293 A

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

2302293

# MANUFACTURE OF COATED PARTICULATE MATERIALS

This invention relates to the manufacture of coated particulate materials, for example to the manufacture of loose particulate material for use as a fluidizable bed in a waste water treatment plant.

Waste water may be treated by gasification, for example by the aeration or oxygenation of sewage or other waste water containing organic matter degradable by the action of oxygen thereon. It has been proposed to provide such a plant where the treatment vessel contains a bed of loose material. Aeration then causes a degree of fluidization of the bed and sustains the growth of a population of microorganisms on the material of the bed.

Patent Application No. PCT/GB94/02795 describes a method and apparatus for treatment of waste water, and in particular discloses loose particulate material for use as a fluidizable bed in the waste water treatment, said material being characterized by particles of a substantially inert mineral adhered to, coated on or coated by plastics material to provide a habitat for microorganisms effective in waste water treatment.

That Application describes such loose particulate material having a density in the range of from substantially 1.0 to substantially 1.3 g/cc, having a specific surface area in excess of approximately 600 $m^2$ per cubic metre of the loose material, and having a particle size range of substantially 3 mm to 10 mm in diameter. An example of the material is particles of sand or gravel or other inert mineral at least partially adhered to, coated on or coated by plastics material, preferably a thermoplastics material such as polyethylene. The material can be produced to a desired density for a particular application by changing the initial proportions of mineral and plastics.

UK Patent Application No. 9502743.9 discloses the

provision of a loose particulate material for use as a fluidizable bed in waste water treatment, said material characterized by granules of plastics material each having a plurality of grains of a substantially inert mineral coated thereon to provide a habitat for microorganisms effective in waste water treatment, said granules having a predetermined particle size range, and said grains having a predetermined particle size range and being disposed at a predetermined packing density range on the granules.

That Application further discloses a method of manufacture of loose particulate material for use as a fluidizable bed in waste water treatment, said method comprising partially melting granules of plastics material of a predetermined particle size range, allowing the partially melted granules to contact a mixture of grains of a substantially inert mineral of a predetermined particle size range and grains of a soluble substance of a predetermined particle size range to coat the granules with the mixture, and substantially dissolving the soluble substance grains from the coating to provide granules coated with said grains of substantially inert mineral in a predetermined packing density range.

The particle size range of those plastics material granules is typically 3 to 10 mm considered as a sieve size range and bearing in mind the generally irregular shape of such granules as commercially available.

A larger number of smaller such grains of mineral will provide a higher specific surface area, and hence it is generally desirable to select a fairly small grain size for the mineral, for example from about 0.1 to 3.5 mm, depending on the requirements for the specific waste water treatment.

The specific gravity of such plastics material is fixed by the choice of plastics material, suitably polyethylene, and is less than 1.0 g/cc. The specific

gravity of the mineral is likewise fixed by the choice of mineral and is substantially greater than 1.0 g/cc. Therefore an initial choice of particle size ranges for a given plastics material and given mineral constrains the specific gravity of the resultant fluidized bed particles to a predetermined value. In general, it would be desired to achieve particles having a specific gravity just slightly in excess of 1.0 g/cc. The mineral is suitably silver sand, also known as washed sand or playpit sand, and is characterized by having a high percentage of grains of fairly uniform size.

The above-mentioned UK Patent Application No. 9502743.9 thus described the manufacture of such loose particulate material wherein it is reasonably possible to predetermine not only the desired particle size ranges of the plastics material granules and the mineral grains thereon, but also the specific gravity of the finished material. That was achieved by appreciating that it is possible to control the effective packing density of the mineral grains in the coating on the plastics material granules. The soluble substance therein may be any economically available granular substance which is soluble in a common solvent, such as water, that does not affect the plastics material or the sand, and provided that it has a melting point higher than the softening point of the plastics material granules, i.e. typically higher than about 200°C. The soluble substance may be common salt, i.e. sodium chloride.

Although the above-mentioned UK Patent Application No. 9502743.9 described such loose particulate material, its use as a fluidizable bed, and its manufacture, it has been found in practice that it is difficult to manufacture the coated particulate material in a reliable, consistent and economical manner, and an object of the present invention is to provide an improved method of manufacturing such loose particulate material.

According to the present invention there is provided a method of manufacturing loose particulate material in the form of granules of plastics material carrying grains of another material, e.g. a mineral, which is stable to a temperature higher than the softening temperature of the plastics material, said method comprising heating the grains to a predetermined temperature greater than the softening temperature of the plastics material granules, providing a quantity of plastics material granules at a lower temperature, tumbling the heated grains together with the plastics material granules whereby the granules become coated with said grains, and allowing the coated granules to cool.

The heated grains are preferably contacted with the granules in a manner such that the granules are always in local excess, whereby to minimize the likelihood of occurrence of hot spots where the heat of a multiplicity of grains could unduly soften some of the granules to the point where they might flow or melt into one another to form unwanted agglomerations.

The method may be carried out on a batchwise or continuous basis. In a batchwise operation, a predetermined quantity of the heated grains are preferably added, e.g. by pouring as a stream, into a predetermined quantity of the plastics material granules. The plastics material granules are preferably provided in a tumbling condition, e.g. in a rotary mixer, while the stream of heated grains is added and the tumbling continues as the granules are coated and commence cooling.

In a continuous operation, a stream of heated grains is arranged to contact a stream of granules and the commingled grains and granules tumbled together upon or immediately after contact to form the coated granules. Such tumbling may continue along an agitated conveyor system.

The tumbling is preferably continued until the coated

granules have cooled down to a temperature at which the granules are no longer significantly soft, whereby they can then reside in quantity without significant mutual deformation under the weight of granules above them. Such tumbling also gives the finished coated granules a generally rounded surface in the manner of pebbles on a beach.

The hot coated granules may be at least partially cooled by the addition of an excess of cold grains into the tumbling coated granules. This effects heat exchange, whereby heat from cooling coated granules is usefully recovered and serves to dry and pre-heat those excess grains for use in a subsequent coating operation.

Where the plastics material granules are of polyethylene, for example recycled shredded/chopped scrap polyethylene, the grains are preferably heated to a temperature in the range 215 to 225°C. The grains are preferably mixed or tumbled during heating to ensure substantially uniform heating to within that temperature range.

The grains may consist of an inert mineral such as sand, for example silver sand as mentioned above.

In preferred embodiments the grains consist of a mixture of two or more materials, for example a mixture of a substantially inert mineral and a soluble substance. The soluble substance may be any economically available granular substance which is soluble in a common solvent, such as water, that does not affect the plastics material or the sand, and provided that it has a melting point higher than the softening point of the plastics material granules, typically higher than about 200°C. The soluble substance is conveniently common salt, i.e. sodium chloride.

The invention also provides apparatus for manufacturing loose particulate material in the form of granules of plastics material carrying grains of another

material, e.g. a mineral, which is stable to a temperature higher than the softening temperature of the plastics material, said apparatus comprising means for heating the grains to a predetermined temperature greater than the softening temperature of the plastics material granules, and means for tumbling the heated grains together with a quantity of plastics material granules initially at a lower temperature, whereby the granules become coated with the grains, and means allowing the coated granules to cool.

An embodiment of the invention will now be described, by way of example.

A mixture of mineral grains is prepared. The mixture consists of silver sand grains and common salt, i.e. sodium chloride, grains. These materials are both of fairly uniform grain size. Care is taken that both minerals are dry, and their respective particle size ranges are selected in accordance with the specified requirements for the finished material. A particular usage of the finished material is as fluidized bed particles of a desired specific gravity for a particular treatment method and plant. For example, the minerals may be initially mixed in the proportions of four volumes of salt to one volume of sand. This is found to result in a finished material having a desired specific gravity of the order of 1.0 g/cc, for particulate material of the dimensions discussed below.

The sand and salt grains are intimately mixed, for example in a tumbling mixer. They are heated to a temperature in the range 215 to 225°C, for example by an infra-red heater or by a hot air or flame heater working within the tumbling mixer. A temperature sensor provides a reading of temperature to indicate when the heating is complete.

A predetermined quantity of plastics material granules are provided in a separate tumbling mixer. The

granules may be of polyethylene, for example recycled shredded/chopped scrap polyethylene, having a particle size range of about 3 mm to about 10 mm typically 8 mm, considered as a sieve size range and bearing in mind the generally irregular shape of such granules as commercially available.

The plastics material granules are at a lower temperature, conveniently at ambient temperature. The plastics material granules are provided as about two volumes to one volume of the salt/sand mixture. The melt flow index or softening temperature of the polyethylene granules is in the range of about 180 to 200°C.

When the sand/salt mixture has attained the desired temperature in the range 215 to 225°C, the plastics material granules are tumbled, and the heated grains are poured in the manner of a stream into the tumbling plastics material granules. The tumbling continues as the heated grains pour in and continues thereafter. By this means, the heated grains are contacted with the plastics material granules in a manner such that the granules are always in local excess, whereby to minimize the likelihood of occurrence of hot spots where the heat of a multiplicity of grains could unduly soften some of the granules to the point where they might flow or melt into one another to form unwanted agglomerations.

Under the above described operating conditions, established after substantial development work, it is found that each granule becomes substantially uniformly and completely coated with a layer of sand/salt mixture on and partially embedded in its outer surface.

The tumbling of the coated granules continues until they have cooled down to a temperature at which the granules are no longer significantly soft. This tumbling also gives the finished coated granules a generally rounded surface in the manner of pebbles on a beach, which is also desirable for end usage as a fluidizable bed in a

waste water treatment plant.

The hot coated granules are preferably at least partially cooled by the addition into the tumbling mixer of an excess of cold sand/salt grain mixture. This effects heat exchange, whereby heat from the cooling coated granules is usefully recovered and serves to dry and pre-heat those excess grains for use in a subsequent coating operation.

When the coated granules have sufficiently cooled so that they can reside in quantity without significant mutual deformation under the weight of granules above them, they may be tipped from the tumbling mixer through a sieve or screen to retain the coated granules while the excess pre-heated sand/salt grain mixture passes through the sieve for use in a subsequent coating operation.

The coated granules are then washed with cold water, preferably while they are still warm. The soluble salt grains dissolve away in the water leaving the granules coated substantially solely with the grains of silver sand. The wash water is then treated to remove the dissolved salt and may be recycled.

**CLAIMS:**

1. A method of manufacturing loose particulate material in the form of granules of plastics material carrying grains of another material which is stable to a temperature higher than the softening temperature of the plastics material, said method comprising heating the grains to a predetermined temperature greater than the softening temperature of the plastics material granules, providing a quantity of plastics material granules at a temperature lower than the softening temperature, tumbling the heated grains together with the plastics material granules whereby the granules become coated with said grains, and allowing the coated granules to cool.

2. A method according to Claim 1 wherein the heated grains are contacted with the granules in a manner such that the granules are in local excess, whereby to minimize the likelihood of occurrence of hot spots where the heat of a multiplicity of grains could unduly soften some of the granules to the point where they might flow or melt into one another to form unwanted agglomerations.

3. A method according to Claim 1 or Claim 2 carried out on a batchwise basis.

4. A method according to Claim 3 wherein a predetermined quantity of the heated grains is poured as a stream into a predetermined quantity of the plastics material granules.

5. A method according to Claim 4 wherein the plastics material granules are provided in a tumbling condition in a rotary mixer while the stream of heated grains is added and the tumbling continues as the granules are coated and

commence cooling.

6. A method according to Claim 1 or Claim 2 carried out on a continuous basis.

7. A method according to Claim 6 wherein a stream of heated grains is arranged to contact a stream of granules and the commingled grains and granules are tumbled together upon or immediately after contact to form the coated granules.

8. A method according to any one of Claims 1 to 7 wherein the tumbling is continued until the coated granules have cooled down to a temperature at which the granules are no longer significantly soft, whereby they can then reside in quantity without significant mutual deformation under the weight of any granules above them.

9. A method according to any one of Claims 1 to 8 wherein the hot coated granules are at least partially cooled by the addition of an excess of cold grains into the tumbling coated granules.

10. A method according to any one of Claims 1 to 9 wherein the plastics material granules are of polyethylene and the grains are heated to a temperature in the range 215 to 225°C.

11. A method according to any one of Claims 1 to 10 wherein the grains are inert mineral grains.

12. A method according to Claim 11 wherein the grains consist of a mixture of grains of a substantially inert mineral and grains of a soluble substance.

13. A method according to Claim 12 wherein the grains

consist of a mixture of sand grains and grains of sodium chloride.

14. Apparatus for manufacturing loose particulate material in the form of granules of plastics material carrying grains of another material which is stable to a temperature higher than the softening temperature of the plastics material, said apparatus comprising means for heating the grains to a predetermined temperature greater than the softening temperature of the plastics material granules, and means for tumbling the heated grains together with a quantity of plastics material granules initially at a temperature lower than the softening temperature, whereby the granules become coated with the grains, and means allowing the coated granules to cool.

15. A method according to Claim 1 and substantially as described herein.

16. Apparatus according to Claim 14 and substantially as described herein.

17. Loose particulate material when made by a method according to any one of Claims 1 to 13 and 15.

18. Loose particulate material when made in apparatus according to Claim 14 or Claim 16.

The Patent Office

12

**Application No:** GB 9512247.9 **Examiner:** Diane Davies
**Claims searched:** 1-13, 15 & 17 **Date of search:** 4 September 1996

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B2E

Int Cl (Ed.6): B05D; B29B; B32B

Other: Online: EDOC, JAPIO, WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | Relevant to claims |
|---|---|---|
| A | WO 9517351 A (Proceff Ltd. *et al*) Whole document: use of coated granules in waste-water treatment. | |
| A | GB 1345811 A (Chemische Werke Huls AG) Whole document: coating thermoplastic resin with powdered mineral material. | |
| A | Abstracts of JP 05038719 A (Polyplastics Co.) Method of coating granular polyarylene sulphide with an inorganic material. | |

| | | | |
|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |